Sept. 4, 1962 D. J. MILLS ET AL 3,051,985

TWO-ROLL MILLS

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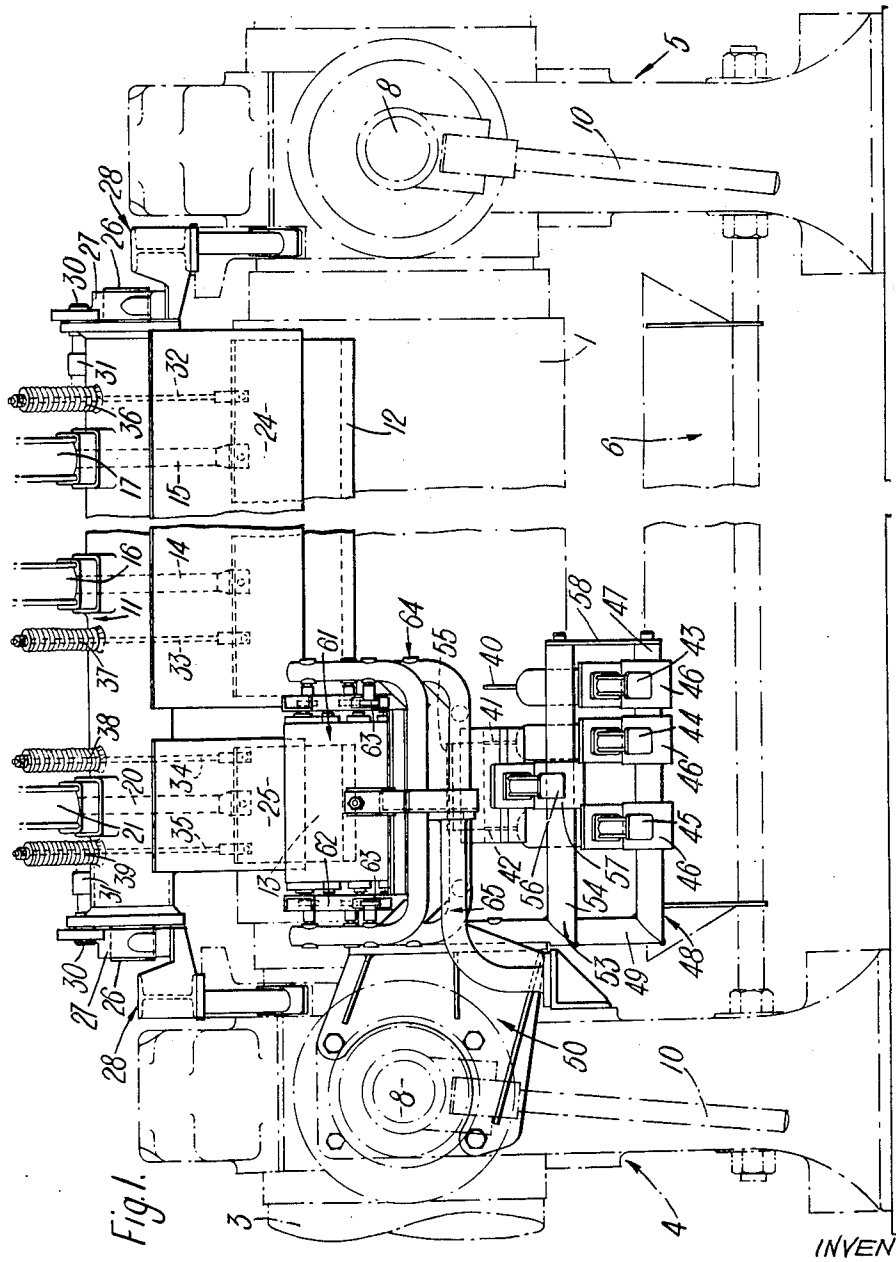


Fig. 1.

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Fig. 3.

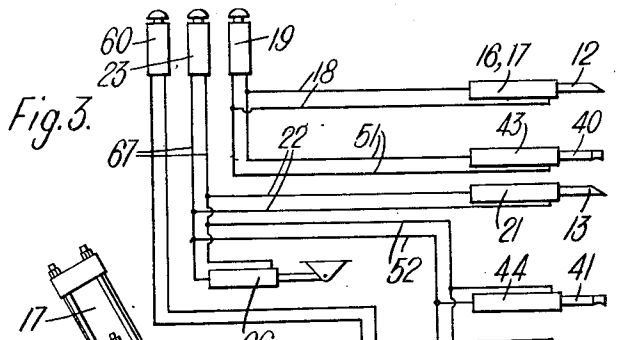
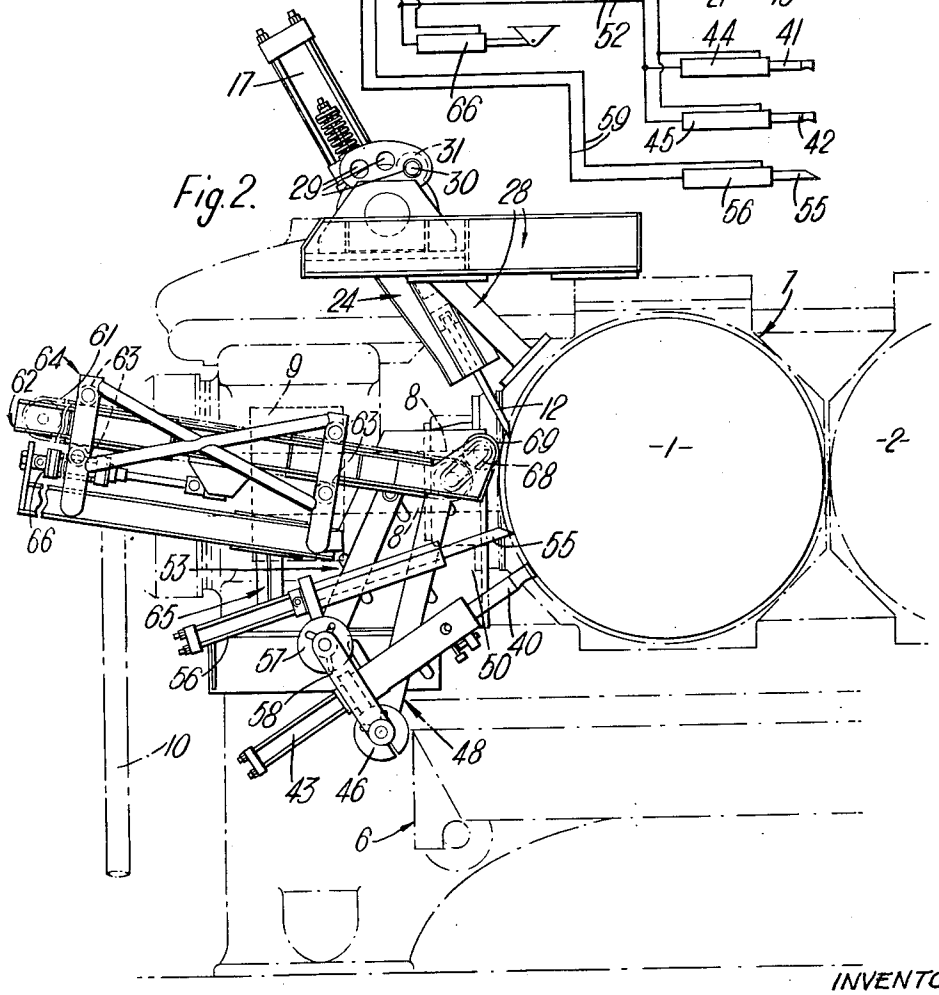


Fig. 2.



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TWO-ROLL MILLS

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This invention relates to improvements in two-roll mills of the kind used as holding or mixing mills for rubber or thermoplastic materials.

In such mills, the material is mixed by being banded around one roller, fresh material being supplied to the nip of the rollers usually at one end thereof, and material being removed from the mill during its operation, by cutting back and removing a strip thereof from the band usually at the end thereof remote from the end of the rollers to which fresh material is fed, whereafter the band automatically re-spreads to cover the length of the roller, drawing the necessary material from the reserve present at the nip.

In operation of such a mill the material is continuously being mixed at the nip by the interchange of material between the band and the reserve present at the nip and by the spreading of the band which takes place after material has been removed therefrom. To increase the mixing action, however, it is customary for an operator periodically to cut back the banded material from the roller, and then to fold the said part of the severed band before rebanding it on the roller.

Such mills in their operation necessarily involve certain disadvantages. Firstly, they require the presence of an operator so increasing their operating cost. Secondly, the effectiveness of the mixing action of such mills depends upon the skill and regularity with which the operator performs the cutting back operation and finally because the operator needs to have access to the surface of the banded roll to perform the cutting back operation, it is difficult to guard the mill fully as is desirable in view of its danger to personnel.

According to the invention there is provided a two-roll mill of the kind referred to including first and second cutting means mounted for independent movement between positions in which they can make sliding contact with the one roller around which in use the material being worked is banded, and positions spaced from the roller and any material banded therearound and means for moving said cutting means between said positions, the first cutting means being adapted upon being moved into sliding contact with the moving roller to cut back material banded around the roller over a major portion of the length of the band extending from or from adjacent to one end thereof and the second cutting means being adapted upon being moved into sliding contact with the moving roller to cut back a narrow strip of material banded around the roller from or adjacent to the other end of the band.

In operation of the mill according to the invention an initial charge is fed to the nip of the roller at the said one end thereof and a strip thereof extruded through the nip is banded around the one roller by hand, preferably for reasons of safety whilst the rollers are stationary. Thereafter, the band automatically spreads over the remaining length of the roller. Material can then be taken from the mill at any time whilst it is running by movement of the second cutting means into contact with the roller to cut back from the banded material a narrow strip of material, the cutting means being left in contact with the roller until the required length of strip has been cut back, the cutting means then being retracted to allow

the strip to begin to be pulled back onto the roller by virtue of its connection with material still banded on the roller, whereupon the second cutting means is brought momentarily into contact with the roller a second time to sever the cut-back strip from the banded material. Alternatively, material can be taken from the mill by simply moving the second cutting means into contact with the roller and maintaining them in contact therewith whereupon if there is no reserve of material at the part of the nip of the rollers whence the strip is being extruded, the strip will be completely severed from the remainder of the material after one complete revolution of the roller, whereas if a reserve of material is present at the said part of the nip, the strip will only be severed from the remainder of the material after such reserve has been exhausted.

Although material can be taken from the mill in either manner just described, it is preferred to provide third cutting means mounted for movement between a cutting position in contact with the said one roller and an inoperative position clear of said roller and any material banded therearound, and means for moving said third cutting means between said positions, said third cutting means being disposed relative to said second cutting means to act in advance thereof so as to be capable of severing material cut back by said second cutting means from material remaining on said one roller.

The operation of the mill with the said third cutting means is as described previously with the exception that to sever the narrow cut back strip to be removed from the mill it is only necessary momentarily to bring the third cutting means into operation.

In order to increase the mixing action of the mill on the material the first cutting means can be moved from time to time into contact with the roller to cut back the material over a major porion of the length of the roller. The first means are not allowed, however, to remain in contact with the roller for sufficient time to allow the cut-back material to be severed entirely from the remainder of the band, but rather are moved back to the said position spaced away from the roller and band of material before this happens, i.e. before the reserve of material at that portion of the nip through which the cut-back material is being extruded, is exhausted. Thereupon the cut-back strip of material is pulled back onto the roller by virtue of its connection with the material still banded on the roller. It can be seen that the end of the cut-back strip, i.e. that part which was first cut-back from the roller, will be the last to be pulled back into it as in being pulled back onto the roller the cut-back strip is folded backwardly on material already on the roller so that a double thickness of material enters the nip which greatly increases the mixing action.

If, as is preferred, the first cutting means are adapted to cut-back material from a portion of the length of the roller extending from one end thereof, it follows that the cut-back strip of material will only be connected at one side to the remainder of the band of material and therefore in being pulled back onto the roller will be diagonally folded. The effect of this is to cause a movement of material from the one end towards the other end of the roller which is found to result in a further improvement in the desired mixing action.

The two-roll mill according to the invention can be controlled by its own operator but by providing for remote control of the means for moving the first and second cutting means and, if included, the third cutting means, the mill can equally well be controlled by for example, the operator of the succeeding or preceding stage in the manufacturing process. Further, the means for moving the several cutting means can readily be automatically controlled in a fully automatic process. Thus it will be

seen that the presence of an operator for the mill is not essential.

It also follows that action of the cutting back operation produced by the first cutting means is constant in its effect and, therefore, a more uniform product results. Furthermore, as the means for moving the cutting means can easily be remotely controlled, it is quite feasible to completely enclose the mill for normal operation, thus greatly reducing the risk of accidents and also greatly facilitating the extraction of fumes from the material being worked.

The means for moving the several cutting means may be operated in any convenient way. They may, for example, be manually operated. Alternately, the said means may be power operated e.g. electrically or by compressed air.

The cutting means may each take various forms. They may, for example, comprise cutting blades extending longitudinally of the roller. With such an arrangement the cutting blades may be mounted parallel to the axis of the roller or alternatively the blades may, if desired, be mounted at an angle to the axis of the roller. In the first alternative, the cutting edges will be straight whereas in the second alternative the edges will need to be contoured to enable them to engage the surface of the roller.

As an alternative to cutting blades which extend longitudinally of the roller, cutting means may be provided which are mounted to be traversed longitudinally of the roller and in contact therewith by, for example, being mounted upon a threaded driven shaft. Such cutting means may be rotary cutters which may be driven, or they may be blades shaped for example, like a plough. Further, the length of the traverse may be capable of variation by adjustment.

The several cutting means need not necessarily be of the same type. Thus the first means may comprise cutting means mounted to be traversed longitudinally of the roller whereas the second and third means may comprise a cutting blade extending longitudinally of the roller over a distance equal to the width of material which it is required to cut back.

It is preferred to provide trimming cutters adapted to cut the band in a direction at right angles to the axis of the roller, so as to sever the material to be cut-back by the first or second cutting means from the material remaining on the roller, the trimming cutters being disposed so as to act in advance of the cutting means. Such cutters are also preferably movable from the cutting position into a position spaced from the roller an material banded thereon. The trimming cutters may be associated respectively with the first and second cutting means for movement therewith between said two positions thereof.

Alternatively the trimming cutters may be mounted independently of the first and second cutting means and circumferentially spaced therefrom around the said roller. Separate means may then be provided for moving the trimming cutters between the said two positions and like the means for moving the said several cutting means, they may be manually, electrically, hydraulically or otherwise suitably operated.

Such an arrangement facilitates accurate adjustment of the cutters to prevent wear of the roller surface. Thus with certain materials it is found to be sufficient that the cutters be adjusted so that in their cutting positions they are actually just spaced from the roller surface thus eliminating altogether frictional wear between them and the roller although in whatever manner they are mounted the trimming cutters may make sliding contact with the roller when in their cutting positions.

The trimming cutters may be rotary cutters which may be driven or idle or they may be cutting blades. The trimming cutters may moreover be spring biased so as resiliently to engage the roller surface.

The trimming cutters may be mounted so as to enable their position to be adjusted longitudinally of the roller thereby enabling the width of the cut-back material to be varied to some extent.

Where the first or second cutting means is adapted to cut the band longitudinally inwardly from one end of the band, then clearly trimming cutters will only be required to sever the cut-back material from that remaining on the roller on one side of the strip of cut-back material, the other side of such strip being the free edge of the band on the roller.

It is also preferred to provide an endless conveyor to take away material cut-back by the second cutting means. Such a conveyor may be separately driven or may be driven by a friction drive off the said one roller.

In order that the invention may be fully understood, one preferred embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

FIGURE 1 is a front elevation of one form of two-roll mill according to the invention;

FIGURE 2 is a part side elevation of the mill of FIGURE 1;

FIGURE 3 illustrates diagrammatically the pneumatic control system of the mill of FIGURES 1 and 2.

FIGURES 1 and 2 show a two-roll mill having rollers **1, 2** of standard length of approximately 5 ft. Such mills include guides (not shown) disposed adjacent the ends of the rollers at the nip therebetween, which serve in use to maintain the ends of a band of material on the roller **1** spaced from the ends of the roller itself. The rollers **1, 2** are mounted between supports **4, 5** and roller **2** is connected by shaft **3** to suitable driving means (not shown) in the conventional manner. A tray **6** is provided below the rollers **1, 2.**

Roller **1** is journalled at each end in a bearing **7**, the bearings **7** are slidably mounted for horizontal movement in the supports **4, 5** so that by movement thereof the spacing of the rollers **1, 2** can be varied as required.

Each bearing **7** is slidably adjusted by a threaded shaft **8** rotatably connected therewith and threadedly engaging a nut **9** fixedly mounted in the respective support **4** or **5.** The ends of the shafts **8** extend to the front of the mill and levers **10** are provided thereon for manual operation.

A tubular beam **11** is mounted between the supports **4, 5** and serves as a mounting for first and second blades **12, 13** constituting first and second cutting means for cutting back material banded on the roller **1.** The blades **12, 13** are both mounted parallel to the axis of the roller **1** for independent movement in a plane inclined away from the roller **1** at an angle of 25° to the vertical between positions in which they make a sliding contact with the surface of the roller and positions spaced about 4" therefrom.

The first blade **12** extends over a major portion of the length of the roller **1** and therefore, of a band of material thereon and extends at the right-hand end of the roller **1** beyond the limit of the band as defined by the right-hand guide so that in operation the blade **12** will cut-back material from the end of the band inwardly over a major portion of its length.

The second blade **13** which is mounted in line with the blade **12** but spaced apart therefrom by about 3" is about 6" in length and the outer end thereof is approximately in line with the left-hand guide.

The blade **12** is mounted by means of two spaced rods **14, 15** passing through the beam **11** and connected to the pistons of air cylinders **16, 17** mounted on the beam **11** respectively. Connections **18** to the cylinders **16, 17** enable movement of the blade **12** to be controlled remotely by an air valve **19** diagrammatically shown in FIG. 3. The second blade **13** is similarly mounted by means of single rod **20** connected to the piston of an air cylinder **21** also mounted on the beam **11** and con-

nected for remote control by connections 22 to an air valve 23.

Guides 24, 25 for the blades 12, 13 respectively are mounted on and depend from the beam 11 and serve also to support the blades against side thrusts arising during cutting-back operations.

As shown in FIG. 2, the cutting edges of the blades 12, 13 are ground to an angle of about 25°.

The beam 11 is rotatably mounted about its longitudinal horizontal axis by trunnions 26 at the ends thereof which are journalled in plain bearings 27 mounted on supports 28 at each side of the mill. Each support 28 is mounted on the respective bearing 7 so that sliding adjustment of the bearings 7 by levers 10 does not affect the relative position of the blades 12, 13 and the roller 1.

Each bearing 27 has associated therewith three apertures 29 arranged on an arc concentric with the axis of the beam 11 for selective engagement by a locating pin 30 slidably mounted in a block 31 fixed to the beam 11. This enables the beam 11 and its blades 12, 13 selectively to be held in the working position shown in FIG. 2 or, with the blades 12, 13, to be swung anti-clockwise and held in that position for easier access to the roller 1.

The blades 12, 13 are also spring biased to the retracted position by rods 32, 33; 34, 35 connected there with and slidably mounted in the beam 11. Compression springs 36, 37; 38, 39 disposed around the rods 32, 33; 34, 35 between upper ends thereof and the beam 11 provide the spring bias for the blades.

Also trimming cutters are provided in the form of trimming blades 40; 41 and 42 for the blades 12, 13 respectively. The trimming blades are mounted independently of the blades 12, 13 in holders respectively mounted on the ends of the piston rods of air cylinders 43; 44 and 45. The air cylinders are mounted on split collars 46 mounted in turn on a horizontally extending tubular member 47. The collars are clamped on the member 47 but by slackening off the clamping screws they may be slidably adjusted thereon. The member 47 forms the horizontal leg of an L-shaped member 48, the other leg 49 of which extends generally vertically and is secured to a mounting bracket 50 fixed to the front face of bearing 7 in the support 4 for the roller 1 so that adjustment of the bearings 7 does not affect the position of the trimming blades relative to the roller 1.

As will be seen from the drawings the trimming blades are mounted below the blades 12, 13 and therefore cut the band on the roller 1 at right angles to the axis of the roller in advance of the blades 12, 13. The trimming blades 40; 41 and 42 will generally be mounted about in line with the ends of blades 12, 13 to prevent drag on the blades 12, 13 during their cutting back operation. However the blades 41, 42 can be more closely spaced if desired to cause a band to be cut back by blade 13 which is narrower than the width of the blade 13.

Connections 51 to the cylinder 43 (FIG. 3) cause blade 40 to be moved with blade 12 under the control of air valve 19. Further connections 52 cause blades 41, 42 to be moved with blade 13 under the control of air valve 23.

Another L-shaped tubular member 53 similar to member 48 is also mounted on bracket 50 so that its horizontal leg 54 is above leg 47. This leg 54 mounts a third cutting blade 55 arranged for movement generally radially of the roller 1 for contacting the roller between the trimming cutters 41, 42 and the blade 13 and of a width sufficient to enable it to sever transversely a band of material being cut back by blade 13 so as to separate such band from material on the roller 1.

The blade 55 is mounted in similar manner to trimming blades 40, 41, 42 namely on the piston rod of an air cylinder 56. The cylinder 56 is mounted on a split collar 57 itself mounted on leg 54 of member 53.

The free ends of legs 47, 54 are connected by a cross-strut 58.

Connections 59 (FIG. 3) to the cylinder 56 enable blade 55 to be remotely controlled by an air valve 60.

Positioned between the third cutting blade 55 and the blade 13 is an endless conveyor 61. The conveyor 61 is mounted on a frame 62 which runs on rollers 63 of a cradle 64 for radial movement towards and away from the roller 1. The cradle 64 is supported by a tubular support 65 mounted as a cantilever on the side of support 4 of the mill. The cradle fixedly mounts a further air cylinder 66 whose piston rod is connected to the underside of the conveyor. Air connections 67 connect this cylinder with air valve 23 so that it is advanced and retracted with the blade 13 and trimming blades 44, 45.

The conveyor 61 is driven through a chain and sprocket drive 68 (FIG. 2) by a drive roller 69 mounted at the front end thereof to be driven by contact with the material banded on the roller 1.

The operation of the mill just described is as follows. Material, e.g. plasticised polyvinyl chloride, is fed to the nip of the rollers 1, 2 at the end thereof remote from the blade 13. With both blades raised the material is banded around the roller 1 in the conventional manner, i.e. by running the roller to extrude a strip of material through the nip and then banding it by hand around the roller. Once a band of material has been formed around a part of the roller it will spread automatically over the length of the roller 1 between the aforesaid guides as the rollers rotate.

The mill is worked with a reserve of material at the nip between the rollers. To assist the mixing action of the mill, the blade 12 is then caused to move into a position in which the cutting edge makes sliding contact with the roller 1 by operating the air valve 19 and in so moving it cut-backs from the roller a strip of material extending over a major portion of the length of the band from one end thereof up to the trimming blade 40 which is also brought into action by operation of valve 19. This cut-back strip falls into the tray 6 and reserve material in the nip continues to be extruded through the nip into this strip. Before the reserve material at the nip is exhausted and, therefore, while the cut-back strip is still connected with the remainder of the band on the roller, the value 19 is operated again to raise the blade 12 back to a position in which it is spaced from the roller and the material thereon.

The cut-back material is now pulled back onto the roller 1 by virtue of its connection at the one side with the remainder of the band and in the process is folded diagonally on itself, which has the effect of transferring material toward the end of the roller 1 remote from the end to which material was first fed. As previously explained, this increases the effectiveness of the mixing action of the mill. The operation of the blade 12 may be repeated as often as desired.

To remove mixed material from the mill the valve 23 is operated to move the blade 13 into a position in which the cutting edge is in sliding contact with the roller 1. Operation of valve 25 also brings trimming cutters 41, 42 and conveyor 61 into action. Thus a narrow strip of material is cut back which falls onto the conveyor 61 and is carried away to the next stage in the manufacturing process. The width of the strip of cut-back material is determined by the spacing of the trimming blades 41, 42 provided that these blades are reasonably near the ends of the blade 13. If too narrow a spacing of the blades 41, 42 were to be attempted, the material being cut-back by the blade 13 might tend to tear away from the remainder of the band near the ends of the blade 13 irrespective of the cutting action of the trimming blades 41, 42 or alternatively too great a strain might be thrown upon the blade 13 depending upon the nature and thick-

ness of the banded material. Practical experiment readily enables such limiting conditions to be determined.

The blade **13** is allowed to remain in contact with the roller **1** until the required length of strip has been cut back. Valve **60** is then operated momentarily so that cutting blade **55** severs the cut-back strip from the material remaining on the roller **1**. Blade **13**, its associated trimming blades and conveyor **61** are then retracted by operation of valve **23** until it is desired to take more material from the mill.

Thereafter, fresh material is supplied to the mill to make up for that removed and the processes described can be repeated regularly to give a continuous operation of the mill.

Although all the blades and the conveyor **61** have been described as being controlled by manually operable valves it is to be understood that such control can readily be exercised automatically according to the needs of the mill and of succeeding and/or preceding stages in the manufacturing process in which the mill is involved.

We claim:

1. A two-roll mill of the kind referred to including first, second and third power operated cutting means mounted for independent movement between positions in which they make sliding contact with one roll around which material being worked is banded, and positions spaced from the roll and any material banded thereabout, and means for moving said cutting means between said positions, the first cutting means being arranged so that in its operable position it cuts back material banded around the roll over a major portion of the length of the roll extending from one end thereof, the second cutting means being arranged so that in its operative position it cuts back a narrow strip of material from the remaining minor portion of the roll, and the third cutting means being disposed circumferentially spaced from and in advance of said second cutting means to sever material cut back by said second cutting means from material remaining on said roll, trimming cutters for cutting a band of material on the roll in a direction at right angles to the axis of the roll so as to sever the material to be cut-back by said first or second cutting blades, said trimming cutters being positioned circumferentially in advance of the first and third cutting means.

2. A two-roll mill as claimed in claim 1 in which said trimming cutters are mounted independently of said first and second cutting blades for movement between a cutting position and a position spaced from said roll and material banded thereon.

3. A two-roll mill as claimed in claim 1 including an endless conveyor for carrying away material cut back by said second cutting means, said conveyor being movable towards and away from said one roll and including a friction drive roller therefor positioned to be brought into engagement with material banded on said one roll upon movement of said conveyor towards said roller.

References Cited in the file of this patent

UNITED STATES PATENTS

1,680,171	Hallenbeck	Aug. 7, 1928
1,923,027	Stevens	Aug. 15, 1933
2,593,282	Engler	Apr. 15, 1952
2,629,129	Hanson et al.	Feb. 24, 1953
2,663,901	Hale et al.	Dec. 29, 1953
2,730,755	Hale et al.	Jan. 17, 1956